5 Recommendations

California's routine databases on emissions and ambient air quality are uncommon in their extent (number of monitors and years of operation) and in their high quality. In addition, many special studies that address air quality issues have been conducted in California. Data from these sources have already answered many questions concerning the ozone weekend effect. However, the objectives of routine programs and special studies have not specifically included understanding day-of-week differences in ozone and other pollutants. It is not surprising, therefore, that explaining the ozone weekend effect will require additional information to augment existing databases.

This chapter presents a multi-disciplinary research program needed to resolve the cause(s) and implications of the ozone weekend effect. No area of research recommended below is likely to suffice by itself. Without a multi-faceted effort, the cause(s) and implications of the ozone weekend effect may remain ambiguous. Chapter 6 in the Technical Support Document provides additional detail concerning these recommendations as a starting point for discussion and planning.

Recommendation #1: Conduct a field study to augment existing ambient air quality databases in the South Coast Air Basin

Existing databases for ambient air quality must be augmented in several respects before the alternative cause(s) of the ozone weekend effect can be resolved.

An expansion of routine sampling methods alone will not suffice. Instead, a significant field study in the South Coast Air Basin is recommended to gather the needed ambient air quality data. A detailed outline for the recommended study is presented in the Technical Support Document.

- **Location and duration**

The field study would take place in the South Coast Air Basin over 18 months comprising two May-October "ozone" seasons and one November-April "winter" season.

- **Scope and resolution of surface air quality measurements**

For every day of the study, hourly surface measurements would include accurate speciation of VOCs, accurate quantification of NMOC, NO_X, NO, NO_2 (direct measurement, not NO_X – NO difference), total reactive nitrogen (NO_Y), ultraviolet sunlight, and PM2.5 (including elemental carbon). The NMOC data

in addition to VOC species are needed to capture the contribution of oxygenated reaction products of VOC emissions. Each of these measurements would be taken at 7 to 12 locations representing major subregions of the SoCAB. Measurements would be made using artifact-free methods that can be deployed in the field.

For at least 15 weekday-weekend transitions (Fri.-Sat.-Sun.-Mon.) during the ozone seasons, hourly surface measurements would include HONO, nitrate radical (NO_3), and PAN.

- **Scope and resolution of air quality measurements "aloft"**

For the same 15 weekday-weekend transitions (Fri.-Sat.-Sun.-Mon.) with augmented surface measurements, additional measurements aloft would include the following: accurate speciation of VOCs, accurate quantification of NMOC, NO_X, NO, NO_2 (direct measurement, not NO_X – NO difference), total reactive nitrogen (NO_Y), ultraviolet sunlight, and PM2.5 (including elemental carbon).

Measurements would be collected hourly during daylight hours and 2 to 4 times during the nighttime hours.

For all sampling periods, measurements would be taken at three or more heights between 50 meters and 1000 meters at four or more locations.

The sampling periods would include a wide spectrum of conditions rather than limiting attention to ozone "episodes." Nevertheless, anticipated ozone maxima should be 70 ppb or more each day at most locations in the basin.

Measurement methods should be artifact-free and as comparable to surface measurement methods as possible.

- **Day-specific hourly profiles for VOC species**

Measurements of VOC species, including oxygenated species, such as formaldehyde and acetaldehyde, would be included frequently enough to determine differences in day-specific hourly profiles for VOCs. Accurate day-specific profiles are needed to address issues relating to carryover of pollutants, source apportionment, and differences in reactivity.

- **Contributions of carryover aloft to surface measurements**

For the same 15 weekday-weekend transitions (Fri.-Sat.-Sun.-Mon.) with augmented surface measurements, tracers would be released aloft before sunrise. Surface measurements of these tracers would help determine how pollutants that carry over aloft contribute to surface measurements the following day.

Recommendation #2: Develop day-specific emission inventories to support efforts to model weekday-weekend differences in ozone

Emission inventories for each day of the week are needed to help determine the causes of the ozone weekend effect. These inventories must reveal in sufficient detail the quantity, the timing, and the location of VOC and NO_X emissions for weekdays, for Saturdays, and for Sundays. Although desirable, separate inventories for the individual weekdays may not be feasible.

Day-of-week emission inventories are needed to support air quality models that simulate the ozone weekend effect. To date, emission inventories used in modeling exercises comparing weekdays and weekends have been, of necessity, rather speculative. Day-specific hourly emissions are needed for stationary and area sources as well as for mobile sources.

Special emphasis may be needed for major source regions in the SoCAB, such as, the South Central area of Los Angeles. This area is a major source region for ozone precursors. The Lynwood monitoring site represents a broad, high emissions area in South Central Los Angeles, which has unusually high concentrations of CO (and presumably VOCs) on Saturday during the mid-day hours (Figure 5.3.40 in the Technical Support Document). Inventories for this and other areas may be crucial for resolving the cause(s) of the ozone weekend effect.

The recommendations in the Technical Support Document address work already planned or in progress and work that may be needed in addition to present plans. The major recommendations include the following:

- Acquire and analyze hourly summaries for on-road vehicle activity by vehicle class throughout the SoCAB.
- Quantify day-specific differences in emissions for important stationary-source and area-source categories.
- Analyze existing data by day-of-week from continuous emissions monitoring (CEM) systems at major industrial sources of NO_X emissions.
- Quantify day-specific emissions for significant source regions, such as South Central Los Angeles.

Recommendation #3: Design and execute modeling studies that address alternative hypotheses concerning the cause(s) of the ozone weekend effect

Modeling exercises would use the new day-specific emission inventories to investigate how the mix of primary and secondary pollutants affects ozone formation on weekdays and on weekends.

Dynamic simulation models such as the Urban Airshed Model (UAM) are important tools for comparing alternative strategies for reducing emissions. Modeling exercises should be used to compare and contrast the effects of periodic emission reductions on weekends to the effects of strategic emission reductions on all days. Only models can make such comparisons because the strategic reductions have not yet occurred.

Effective and reliable simulations require satisfactory agreement between model predictions and appropriate "base cases." The modeling exercises recommended here should not be carried out until such base cases have been developed based on the recommended improvements in air quality and emissions activity data. When satisfactory base cases characterizing day-of-week emissions are available, a carefully designed series of modeling exercises would be run.

These exercises should including the following tasks:

- Compare modeled concentrations of pollutants aloft with measured concentrations observed in field studies. A minimal effort might use SCOS97 data for this task.
- Conduct model performance evaluations specifically with respect to factors that are relevant to the alternative hypotheses in Chapter 2.
- Model the effects of different sequences of weekday (WD), Saturday (SA) and/or Sunday (SU), emissions.
- Model the effects of different sequences of "future" WD, SA, and SU emissions that represent strategic emission reductions. These exercises should ensure that the initial conditions, the boundary conditions, and the modeled concentrations aloft appropriately reflect the lower "future" emissions.
- Compare model results that help discriminate between the alternative causes of the ozone weekend effect. For example, the NO_X-reduction hypothesis could be evaluated by comparing a present-day sequence of WD, SA, SU, WD to a sequence of "future" weekdays, WD1, WD2, WD3, WD4 (where WD1=WD2=WD3=WD4=(SA + SU)/2. If the NO_X-reduction hypothesis is correct, then ozone levels on the present-day SA and SU should be similar to the ozone levels on the "future" WD2 and WD3, respectively.

Recommendation #4: Update and extend laboratory data concerning alternative causes of the ozone weekend effect

Earlier experiments would be updated based on present-day conditions in the SoCAB. New experiments would be conducted to address important alternative causes of the ozone weekend effect.

Many past experiments have already revealed important aspects of ozone-producing systems. However, these experiments were often designed from a generic perspective, and they may not be directly applicable to the ozone weekend effect. These experiments should be repeated based on the conditions found during the air quality studies recommended above.

- Evaluation of chemical mechanisms when VOC/NO_X ratios and NO_X concentrations are both low.
- Evaluation of NO_X-timing effects.
- Evaluation, as possible, of the effects of carryover aloft.

In addition, new experiments should be carried out to identify and quantify a spectrum of air pollutants that could play significant roles in the ozone weekend effect. Other experiments might be designed to isolate important points that help discriminate between the alternative causes of the ozone weekend effect. For example, the “carryover near the surface” hypothesis might be evaluated, in part, by examining the specific reactivity of air near the surface on Friday, Saturday, Sunday, and Monday at 4 a.m. and at 8 a.m.

(This page intentionally left blank.)